



2019 Minerals Yearbook

TUNGSTEN [ADVANCE RELEASE]

TUNGSTEN

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In 2019, there was no domestic production of tungsten concentrates. Most of the U.S. supply of tungsten raw materials consisted of imports, scrap, and sales from the National Defense Stockpile (NDS). Total U.S. imports of tungsten decreased by 4% compared with imports in 2018 (tables 11–14). On the basis of total estimated tungsten content, China continued to be the leading supplier of tungsten in materials and products imported by the United States. In 2019, U.S. net production of tungsten materials was slightly less than that in 2018 (tables 1, 3).

U.S. reported consumption of tungsten materials in 2019 was essentially unchanged from that in 2018 (table 1). Cemented carbide parts for cutting and wear-resistant applications was the leading end use for tungsten and accounted for nearly 60% of consumption (table 5). U.S. apparent consumption (defined as mine production plus secondary production plus imports minus exports plus adjustments for Government and industry stock changes) decreased compared with that in 2018.

In 2019, world tungsten mine production was slightly higher than that in 2018 and reached a record-high level of 83,800 metric tons (t) of tungsten content (tables 1, 15). Roskill Information Services Ltd. (Roskill Information Services Ltd., 2020, p. 6, 23) estimated that the 2019 world tungsten market was in deficit, partly because of a decrease in secondary (scrap) supply, owing to lower prices. Tungsten supplies were supplemented by a drawdown in inventories. Key issues that influenced the market in 2019 included the restart of production from Chinese mines and ammonium paratungstate (APT) plants during the second half of 2018, following suspensions associated with environmental inspections during 2017 and 2018; a decrease in Chinese consumption owing in part to reduced output by China's automotive industry; a decrease in non-Chinese tungsten demand (for consumption or stocks), as indicated by a decrease in imports of tungsten raw materials by various regions; and uncertainty in the supply-demand outlook resulting from trade disputes between the United States and China. Concerns over the eventual dispersal of large stocks of APT formerly held by the defunct Fanya Metal Exchange (China), were lessened in September, when the entire inventory was sold to a major Chinese tungsten producer (Radford and others, 2019; International Tungsten Industry Association, 2020, p. 5–6, 16; Roskill Information Services Ltd., 2020, p. 1–2, 58–59, 96–97).

Most data in this chapter have been rounded to no more than three significant digits. Totals and percentages were calculated from unrounded data. Unless otherwise specified, all statistics in this chapter are in metric tons of tungsten content. Most tungsten prices and many tungsten statistics from sources other than the USGS are quoted in units of tungsten trioxide (WO_3). The short ton unit, which is used in the United States, is 1% of a short ton (20 pounds), and WO_3 is 79.3% tungsten by weight. A short ton unit of WO_3 , therefore, equals 20 pounds of WO_3 and contains 7.19 kilograms (kg) (15.86 pounds) of tungsten. The

metric ton unit, which is used in most other countries, is 1% of a metric ton (10 kg). A metric ton unit of WO_3 , therefore, equals 10 kg of WO_3 and contains 7.93 kg (17.48 pounds) of tungsten.

Legislation and Government Programs

Critical Minerals.—In 2018, the U.S. Department of the Interior (DOI), in coordination with other executive branch agencies, published a list of 35 critical mineral commodities, including tungsten. In June 2019, the U.S. Department of Commerce released “A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals.” The Commerce strategy report had several recommendations for DOI to take the lead or assist in achieving goals, including locating domestic sources of critical minerals, providing information for the study and production of critical minerals, and evaluating regulations to provide timely processing of permit applications for mineral projects (U.S. Department of the Interior, Office of the Secretary, 2018; U.S. Department of Commerce, 2019, p. 10, 20, 24, 33–36, 40–43).

National Defense Stockpile.—During fiscal year 2019 (October 1, 2018, through September 30, 2019), the U.S. Department of Defense, Defense Logistics Agency Strategic Materials (DLA Strategic Materials), sold 805 t of tungsten in ores and concentrates; 798 t of tungsten in ores and concentrates was sold during calendar year 2019. The quantities of tungsten materials remaining in the stockpile at the end of the calendar year are listed in tables 1 and 2.

The Annual Materials Plan for fiscal year 2019 provided the maximum quantities of tungsten materials available for disposal, as listed in table 2. The quantities of tungsten ores and concentrates and tungsten metal powder available during fiscal year 2020 (October 1, 2019, through September 30, 2020) remained unchanged. In addition to disposals, DLA Strategic Materials listed the possible acquisition of 5 t, gross weight, of tungsten-rhenium metal in fiscal year 2019, unchanged from that in fiscal year 2018. The quantity of tungsten-rhenium metal that could be acquired in fiscal year 2020 remained at 5 t (Defense Logistics Agency Strategic Materials, 2017, 2018, 2019a, b).

Conflict Minerals.—The U.S. Securities and Exchange Commission (SEC) implemented section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act, which was related to the use of minerals determined to be financing conflict in the Democratic Republic of the Congo [Congo (Kinshasa)] or an adjoining country. Section 1502 defined “conflict minerals” as cassiterite, columbite-tantalite, gold, wolframite, or their derivatives. Wolframite is one of two principal minerals mined for tungsten. The act required U.S. publicly-listed companies for which conflict minerals or their derivatives were necessary to the functionality or manufacture of their products to disclose annually whether any of those minerals originated in Congo (Kinshasa) or an adjoining

country (U.S. Securities and Exchange Commission, 2012, p. 56274–56275).

In 2020, the U.S. Government Accountability Office (GAO) published an overview of the conflict minerals disclosures submitted for 2019. A GAO analysis of a sample of 2019 filings estimated that 50% of the companies were able to make preliminary determinations of their conflict minerals' country of origin, a decrease from 56% of the companies that filed in 2018. The ability of reporting companies to identify the country of origin of their conflict minerals continued to be hindered by lack of access to suppliers and complex supply chains involving many suppliers and processing facilities. In addition, some companies reported that their suppliers did not respond to requests for information. In 2019, for those companies that conducted due diligence on the source and chain of custody of the conflict minerals in their products, an estimated 68% could not confirm definitively the source of the conflict minerals, as compared with 61% in 2018. Almost all these companies reported that they could not determine whether the minerals in their products financed or benefited armed groups. Although reporting companies were not required to identify which conflict minerals they used, of those that did, 63% reported using tungsten. Tungsten concentrate production from Congo (Kinshasa) and adjoining countries had been only 1% to 2% of world production in recent years (table 15) (U.S. Government Accountability Office, 2020, p. 12–18, 20).

Production

Domestic production statistics for tungsten are based on data collected by the U.S. Geological Survey (USGS) by means of two separate voluntary surveys. Statistics that result from these surveys are listed in tables 1 and 3. The annual “Tungsten Ore and Concentrate Survey” covered the production, purchase, disposition, and stocks of tungsten ores and concentrates. There was no known domestic production of tungsten concentrates in 2019.

The USGS monthly “Tungsten Concentrate and Tungsten Products Survey” canvassed companies that consumed APT, tungsten-bearing scrap, and (or) tungsten concentrate to produce tungsten carbide powder, tungsten chemicals, and (or) tungsten metal powder. Where possible, data for nonrespondents to the survey were estimated based on prior survey results or information from other sources. U.S. processors of tungsten materials are listed in table 4. Total net production of tungsten metal powder and tungsten carbide powder was slightly less than that in 2018 (table 3).

Consumption

Tungsten is a whitish-gray metal with the highest melting point of all metals and one of the highest densities. When combined with carbon to make tungsten carbide, it is almost as hard as diamond. These and other properties make tungsten useful in a wide variety of important commercial, industrial, and military applications. The leading use was as tungsten carbide in cemented carbides, which are wear-resistant materials used primarily by the construction, metalworking, mining, and

petroleum and natural gas drilling industries (International Tungsten Industry Association, 2009, p. 5, 8, 124).

The main use of tungsten metal powder was to make tungsten carbide powder. Tungsten metal powder also was used to make coils, contacts, disks, electrodes, filaments, structural parts, reflectors, and wires in electrical, electronic, heating, lighting, and other applications. When combined with other metals or materials, tungsten metal powder was used to make alloys and composites to substitute for lead in ammunition and other products; heavy-metal alloys for kinetic energy penetrators and fragmentation devices, radiation shielding, rigid tools for machining, rotating inertia members, and weights and counterweights; and a variety of other alloys for numerous products (International Tungsten Industry Association, 2009, p. 7, 9, 67, 95, 105–108, 115).

Ferrotungsten, a master alloy of tungsten and iron, was mainly used to make tool steels. Tungsten chemicals were used to make catalysts, dyes and pigments, lubricants, phosphors, and semiconductors. Tungsten-containing scrap was used as a substitute for other tungsten materials in a number of end-use applications, including catalysts, cemented carbides, superalloys and stellites (corrosion- and wear-resistant alloys), and tool steels (International Tungsten Industry Association, 2009, p. 61–62, 69–70, 108, 110–111).

Statistics on consumption of tungsten in end-use applications by U.S. metal consumers were developed from the voluntary “Consolidated Consumers Survey.” For this survey, nearly 50 tungsten consumers were canvassed on a monthly or annual basis. Reported consumption and stocks data in tables 1 and 5 include estimates to account for nonrespondents. U.S. reported consumption of tungsten materials in 2019 was essentially unchanged from that in 2018. Nearly 60% of U.S. tungsten consumption was used to produce cemented carbide parts.

Weekly reports of the number of operating drilling rigs give an indication of the demand for tungsten carbide in the form of cemented carbide components used to explore for or produce petroleum and natural gas. In 2019, the number of rigs operating each week in the United States trended downward. The average number of weekly operating rigs in 2019 was 9% less than the average number of operating rigs in 2018 (943 rigs in 2019 compared with 1,032 rigs in 2018) (Baker Hughes Inc., 2020).

U.S. apparent consumption of all tungsten materials, as calculated from net imports, secondary production, and changes in Government and industry stock levels, was withheld in 2019 to avoid disclosing company proprietary data pertaining to scrap consumption.

Prices

After trending upward for 2 years, annual average 2019 U.S. prices for tungsten concentrate, APT, and ferrotungsten each decreased from that in 2018. The weekly U.S. spot price for tungsten ore concentrate reported by S&P Global Platts Metals Daily (Platts) remained unchanged throughout the year at \$240 to \$250 per short ton unit (\$265 to \$276 per metric ton unit). The annual average of Platts' U.S. tungsten ore concentrate spot prices decreased by 17% from that in 2018 (table 1).

The weekly U.S. APT price reported by Platts began 2019 at \$280 to \$290 per short ton unit (\$309 to \$320 per metric ton unit), remained unchanged until late October, when it decreased to \$250 to \$260 per short ton unit (\$276 to \$287 per metric ton unit) and remained at that price range until yearend. The annual average of Platts' U.S. APT prices in 2019 was 15% lower than that in 2018 (table 1).

The U.S. free market ferrotungsten price reported by Platts followed a similar pattern. It started 2019 at \$33 to \$35 per kilogram of tungsten content, remained unchanged until late October, when it decreased to \$24 to \$26 per kilogram of tungsten content and remained at that price range until yearend. The annual average of Platts' U.S. free market ferrotungsten price was 30% lower than that in 2018 (table 1).

In mid-September, the entire inventory of APT from the defunct Fanya Metal Exchange (China) was sold at auction to a leading Chinese tungsten producer. Uncertainty about whether the release of Fanya's large inventory of APT would flood the market was a concern since the exchange ceased operations in 2015. Soon after the auction was concluded, Chinese and European APT prices began to trend upward. More information on the Fanya award can be found in the "China" section (Radford and others, 2019; Fastmarkets MB, undated).

At yearend, the city of Ganzhou in Jiangxi Province, China, launched the Ganzhou Rare Metal Exchange for trading tungsten and other rare metals (Clarke, 2020).

Foreign Trade

The tungsten content of U.S. exports in 2019 was 3,370 t, 4% less than the 3,500 t exported in 2018 (tables 6–10). The tungsten content of U.S. imports was 13,900 t, 4% less than the record high of 14,400 t imported in 2018 (tables 11–14). China remained the leading supplier of imported tungsten to the United States, accounting for 31% of all tungsten imports in 2019. The tungsten content of imports from China was 4,320 t in 2019, 7% less than the revised 4,670 t in 2018. The distribution of materials imported from China was as follows: tungsten metal powder, 25%; tungsten carbide powder, 24%; APT, 19%; wrought tungsten, 10%; tungsten waste and scrap, 9%; tungsten oxides, 7%; unwrought tungsten, 5%; and ferrotungsten, ores and concentrates, other tungstates, and other tungsten compounds, less than 1% each. Other countries that supplied 5% or more of United States tungsten imports were Germany (10%), Bolivia (9%), Canada (7%), and Vietnam (6%).

In 2019, the tungsten content of U.S. imports of ores and concentrates was 32% less than that in 2018. The leading suppliers of imports of tungsten ores and concentrates in 2019 were Bolivia (44%), Portugal (19%), Spain (10%), Nigeria and Russia (7% each), and Mongolia (6%) (table 11).

U.S. imports of APT in 2019 were 35% less than those in 2018 (table 12). In 2019, most of the APT imports were from China (58%) and Germany (42%), and less than 0.5% was from Japan. Imports of other tungsten materials are presented in tables 13 and 14.

Net import reliance as a percentage of apparent consumption is one measure of the adequacy of current domestic production to meet demand. Net import reliance is defined as imports minus exports plus adjustments for Government and industry stock

changes. Releases from stocks, including shipments from the NDS, were counted as part of import reliance, regardless of whether they were imported or produced in the United States. In 2019, U.S. net import reliance for tungsten as a percentage of apparent consumption was more than 50%. The actual value was withheld to avoid disclosing company proprietary data.

World Review

Estimated world production of tungsten concentrates in 2019 was slightly higher than that in 2018 (revised) and reached a record-high level, although it was only minimally higher than the previous record production in 2015. China continued to be the leading producer of tungsten concentrates, accounting for 82% of total world production in 2019. Vietnam was the second-ranked producing country, with 5% of world production, followed by Russia, with 3%. Combined production outside of China decreased by 14% in 2019 but was more than balanced by the increase in estimated production from China (table 15).

Most of the world's tungsten was mined from industrial-scale mechanized mining operations. Artisanal and (or) small-scale mining accounted for all or some of the tungsten mined in Bolivia, Brazil, Burundi, Congo (Kinshasa), Nigeria, Rwanda, Uganda, Vietnam, and possibly Burma, North Korea, and elsewhere. World tungsten mine production was supplemented by tungsten recovered from scrap to supply global consumption. Industry analysts estimated that, in 2019, tungsten concentrates represented 72% to 75% of global tungsten supply, and tungsten scrap represented 25% to 28% (International Tungsten Industry Association, 2020, 2, 6; Roskill Information Services Ltd., 2020, p. 23, 135, 180, 187, 195, 202; Sparks, 2020).

Australia.—Two companies produced tungsten concentrate in 2019—Specialty Metals International Ltd. and Tasmania Mines Ltd. Tasmania Mines produced a small amount of byproduct scheelite concentrate from its Kara open pit magnetite mine south of Burnie in Tasmania. Specialty Metals International and Cronimet Australia Pty. Ltd. established Mt. Carbine Retreatment Management Pty. Ltd., an unincorporated joint venture, to produce tungsten concentrates from stockpiled tailings and low-grade ore west of Port Douglas in northern Queensland. By late December, the joint venture began commissioning at its newly refurbished Mt. Carbine retreatment plant and produced tungsten concentrate from stockpiled tailings (Specialty Metals International Ltd., 2019a, b; Geoscience Australia, 2021, p. 76).

King Island Scheelite Ltd. (KIS) completed a feasibility study on reestablishing open pit mining and beneficiation operations at the former King Island Scheelite Mine on Tasmania's King Island. The proposed operation would produce 13,400 t of tungsten in gravity and flotation concentrates during an 8-year mine life, with a maximum annual production of nearly 2,700 t of tungsten in concentrate in year 7. In April, KIS signed a 4-year offtake agreement with Wolfram Bergbau und Hütten AG (WBH, owned by Sandvik AB, Sweden) for about 280 metric tons per year (t/yr) of tungsten in concentrate. Although KIS was able to secure loans for working capital and to purchase property adjacent to the mine, the company needed to raise additional funding to develop the project. KIS forecast the mine and beneficiation plant could be commissioned within

15 months of finalizing financing (King Island Scheelite Ltd., 2019a, p. 24–25; 2019b; 2020, p. 16–17).

Austria.—WBH operated the Mittersill scheelite mine and beneficiation plant in the State of Salzburg. The Mittersill Mine supplied concentrate feed for WBH's Bergla processing plant near St. Martin in the State of Styria. The Bergla plant also processed imported tungsten concentrates, secondary raw materials (scrap), and intermediate products such as APT, sodium tungstate, and tungsten oxides (Wolfram Bergbau und Hütten AG, 2020, p. 1–2).

Brazil.—In recent years, Brazilian tungsten mine production has been from a number of small-scale operations. Mineração Pará Tungstênio Ltda. reportedly planned to start production from a large-scale tungsten mine in 2021 near the municipality of Rio Maria in Para State. The initial open pit mine would have a production capacity of 950 t/yr of tungsten in wolframite concentrate, which could be followed by the development of an underground mine (Roberts, 2020a; Roskill Information Services Ltd., 2020, p. 135; Mineração Pará Tungstênio Ltda., undated).

Burma.—The Directorate of Investment and Company Administration granted permission to Global South Industrial Co., Ltd. (GSIC) to build a tungsten and tin processing plant in Loikaw, Kayah State. The plant would be used to process tin-tungsten ore mined near the border of Kayah and Shan States by GSIC, a joint venture between China-based Hunan Global South Industrial Co., Ltd. and Yadanar Kaday Theik Co., Ltd., which was based in Kayah State. Products from the plant would be exported, mainly to China (Kantarawaddy Times, 2019; Thiha Ko Ko, 2019).

Canada.—The government of the Northwest Territories and the Government of Canada asked Alvarez & Marsal Canada Inc., the court-appointed monitor of North American Tungsten Corp. Ltd. (NATC), to assist them with their plan to find a buyer for NATC's Cantung Mine and Mactung deposit. In 2015, NATC had financial problems and was granted protection from its creditors under the Companies' Creditors Arrangement Act. Since then, the Government of Canada has provided funding to keep the Cantung Mine under care-and-maintenance status and the Northwest Territories has owned the Mactung deposit. In August, Alvarez & Marsal released a request for qualifications to identify interested and qualified entities that would be invited to participate in a request for proposals regarding the purchase of assets and the management of environmental liabilities at the Cantung mine site (Alvarez & Marsal Canada Inc., 2019, p. 1).

In July, the Sisson tungsten-molybdenum project [Northcliff Resources Ltd. and Todd Minerals Ltd. (New Zealand)] in east-central New Brunswick received an important permitting milestone—the Metal and Diamond Effluent Regulations Schedule 2 amendment. During the year, Northcliff continued to optimize engineering designs, work on the Provincial environmental impact assessment, seek offtake interest for the mine products, and discuss project financing. Northcliff planned to update the 2013 feasibility study on the project, which proposed an open pit mine, a beneficiation plant to produce tungsten and molybdenum concentrates, and an onsite processing plant to convert the scheelite concentrate to APT. APT production was expected to average approximately

4,420 t/yr of tungsten content during the 27-year mine life (Northcliff Resources Ltd., 2019; 2020a, p. 6; 2020b, p. 3–5).

China.—In 2019, China's production of concentrates increased by 6% to an estimated 69,000 t of tungsten content, which accounted for 82% of world production (table 15). Despite its position as the world's leading producer of mined tungsten, China imported significant quantities of tungsten concentrates in recent years. In 2019, China imported 1,460 t of tungsten in concentrates, 57% less than the 3,430 t (revised) imported in 2018. China's imports of tungsten concentrates in 2019 represented 10% of global production outside China. The leading sources of these imports were North Korea (77%) and Mongolia (12%). Scrap recycling also contributed to China's tungsten raw materials supply (Roskill Information Services Ltd., 2020, p. 141–142; United Nations Statistics Division, undated).

In mid-2019, some of China's tungsten mining companies and APT producers agreed to halt or reduce production in response to low tungsten prices. After the price of tungsten concentrate fell below the cost of production and continued to decrease, the China Tungsten Industry Association asked tungsten miners to cut their concentrate production by 10%. Similarly, downward trending APT prices prompted 17 APT producers to meet and agree to either halt production for at least 15 days or to reduce production by at least 30% (Fu, 2019b; SMM News, 2019).

The Ministry of Industry and Information Technology had standards for the tungsten industry, which included minimum production levels and operational lives for mines; minimum production capacities for APT, ferrotungsten, and recycling plants; and detailed requirements for comprehensive use of resources and energy consumption, environmental protection, equipment, production safety and skills, product quality, and regulatory management. In late 2018, the Government released guidance for centralizing the tungsten processing industry in Hunan and Jiangxi Provinces (Roskill Information Services Ltd., 2020, p. 143–144).

The Government regulated the production of tungsten concentrates by requiring exploration and mining permits, prohibiting foreign investment in tungsten exploration and mining, setting production quotas, and performing environmental and safety inspections. In late 2018, the Government announced that the approval of tungsten mining licenses would remain suspended except for specific cases, such as for applicants that were state-owned producers or applications for mines in areas of high poverty. The Government regulated tungsten exports by issuing export licenses (Fu, 2019a; Zhang and others, 2019; Roskill Information Services Ltd., 2020, p. 140–146).

China's Ministry of Natural Resources increased the total tungsten concentrate production quota for 2019 by 5% to 105,000 t (65% WO_3), equivalent to approximately 54,100 t of tungsten content. Of the quota, 74% was for operations mining tungsten as the principal product and 26% was in the comprehensive use category, which represented tungsten produced as a coproduct or byproduct, mainly from molybdenum mining. China's concentrate production was typically greater than the quota. For example, the 2019 quota of 105,000 t (65% WO_3) was equivalent to approximately 54,100 t of tungsten content, but production was estimated to be 69,000 t of tungsten content (Ministry of Natural Resources, 2019).

At an auction on September 17, China's Kunming Intermediate People's court awarded the entire inventory of APT from the defunct Fanya Metal Exchange to China Molybdenum Co., Ltd. The award totaled 28,336 t, gross weight, of APT (containing an estimated 19,800 t of tungsten) and was equivalent to about 3 months of China's APT production. Some of the APT reportedly had deteriorated in quality while in storage, meaning that it would likely need to be reprocessed before being consumed. In late November, the Kunming court sold Fanya's former inventory of tungsten bars, representing nearly 432 t, to China Minmetals Corp. (Metal Bulletin Daily, 2018; Radford and others, 2019; Xu and Daly, 2019).

Congo (Kinshasa).—In recent years, artisanal miners have produced tungsten concentrate from Maniema, Nord-Kivu, and Sud-Kivu provinces. As discussed in the "Legislation and Government Programs" section, companies reporting to the United States SEC were subject to the conflict minerals rules in the Dodd-Frank Wall Street Reform and Consumer Protection Act with regard to tungsten exports from Congo (Kinshasa) and adjoining countries. In 2019, Congo (Kinshasa), Burundi, Rwanda, and Uganda each participated in the International Tin Association Ltd.'s ITA Tin Supply Chain Initiative (iTSCi) to assist companies with due diligence and responsible sourcing of minerals from high-risk areas by establishing traceability in the supply chains for tantalum, tin, and tungsten from the mines to the processors (International Tin Association Ltd., 2020, p. 2–10).

Germany.—Saxony Minerals & Exploration AG constructed an exploratory shaft in the Pöhla-Globenstein deposit in Saxony and processed some of the ore extracted in a pilot plant at Mittweida to produce tungsten, tin, and fluor spar concentrates. By yearend, Saxony reportedly was finishing a feasibility study for an operation with the capacity to produce 2,000 t/yr of tungsten concentrate (containing approximately 1,000 t/yr of tungsten) and was working on financing for the project, with the aim of starting construction of the mine's main ramp in 2021 (Roskill Information Services Ltd., 2020, p. 170; Saxony Minerals & Exploration AG, 2020, p. 4–5, 7–8, 14).

Kazakhstan.—Zhetisu Tungsten Jiixin International Resources Investment Ltd. (China) invested in the development of an open pit tungsten mine and beneficiation plant at the Bakuta deposit (also referred to as Boguta or Boguty) in Almaty Oblysy. Construction was planned to begin in 2020, so that production could potentially start in 2022 (Shanghai International Mining Exchange, 2016; Roberts, 2020b).

Korea, Republic of.—Almonty Korea Tungsten Corp. (a wholly owned subsidiary of Woulfe Mining Corp., which was fully owned by Almonty Industries Inc.) continued to work on financing for and development of its Sangdong tungsten project southeast of Seoul in Gangwon Province. During 2017–18, Almonty signed an engineering, procurement, and construction contract for the development and construction of the beneficiation plant and entered a 10-year offtake agreement with U.S. tungsten processor Global Tungsten & Powders Corp. for concentrate from the mine. In 2019, Almonty signed an agreement for the construction and installation of a power line to the mine, entered into a contract for the construction of several buildings, and announced the commissioning of a government-subsidized pilot plant for testing the beneficiation process. By

January 2020, Almonty had received a binding commitment letter from KfW IPEX-Bank GmbH for financing to develop and operate the mine. Based on a 2016 feasibility study, ore from the underground mine would be processed by mineral flotation to produce a scheelite concentrate during a mine life of 8 years. The capacity of the project would be approximately 2,000 t/yr of tungsten in concentrate (Wheeler and Wells, 2016, p. 193, 282; Almonty Industries Inc., 2019, p. 18; 2020a, p. 6–10; 2020b, p. 9–10).

Portugal.—During the year, Almonty continued to focus on cost reduction at the Panasqueira Mine and beneficiation plant in Covilha, Castelo Branco District. Production of tungsten in wolframite concentrate decreased by 28% from that in 2018. The decrease was attributed to a decision to mine lower grade ore while work was done to ensure future access to higher grade ore and to a reduction in the amount of ore mined and processed. As the year progressed, the grade of ore mined and the tungsten recovery rate improved. Cronimet Mining Processing SA Pty. Ltd. continued to install X-ray ore sorting equipment to treat tailings from Panasqueira's heavy-media separation unit. This equipment was expected to be operational in 2020 and to increase the mine's overall tungsten recovery rate by 10% (Almonty Industries Inc., 2020b, p. 8, 12).

W Resources PLC (United Kingdom) continued to work towards trial mining at its Régua project, 95 kilometers east of Porto in north-central Portugal. W Resources planned to develop a low-cost underground mine, transport the ore to a nearby existing crushing plant in Portugal, and then process the crushed ore to concentrate at W Resource's La Parrilla tungsten operation in Spain (W Resources PLC, 2020a, p. 3).

Russia.—In 2019, tungsten was mined from four tungsten deposits and two tin deposits and recovered from one tailings deposit. Ninety-three percent of the tungsten produced in Russia was from the following four operations, in descending order of tungsten production: Primorsky GOK JSC's Vostok-2 tungsten mine in Primorskiy Kray; CJSC Novoorlovsky GOK's Spokoininskoe tungsten mine in the Transbaikal region; JSC Zakamensk's Barun-Narynskoe operation, which produced concentrates from tailings in Buryatiya Republic; and LLC Lermontovsky Mining and Processing Plant's (KGUP "Primeploenergo") Lermontovsky tungsten mine in Primorskiy Kray (Ministry of Natural Resources and Ecology of the Russian Federation, 2020, p. 246–247, 251).

Wolfram Company JSC started trial production at its Primorwolfram LLC underground mine at the Zabytoe tungsten-tin deposit in Primorskiy Kray, with the objective of determining the optimum beneficiation process in a newly constructed pilot plant. This was the first greenfield primary tungsten mine developed since the breakup of the Soviet Union and was expected to produce about 80 t of tungsten in concentrate by yearend 2019, 400 t in 2020, and 550 t in 2021. The company also had licenses to develop the nearby Lazurnoe and Verkhnepriiskovoe deposits (Gorbachev, 2019, p. 21, 24; Ministry of Natural Resources and Ecology of the Russian Federation, 2020, p. 247–249; Sparks, 2020).

The remaining tungsten was mined from two tin operations in the Khabarovsk Territory. Only one of these operations, LLC Pravourmiyskoe, produced tungsten concentrate

(Ministry of Natural Resources and Ecology of the Russian Federation, 2020, p. 247).

In 2019, tungsten concentrates were processed into APT and yellow tungsten oxide at two hydrometallurgical plants—Kirovgradskiy Zavod Tverdykh Splavov OAO's Kirovgrad Hard Alloys plant in Sverdlovsk Oblast and Wolfram Company's Hydrometallurg plant at Nalchik, Kabardino-Balkariya Republic. Two operations produced ferrotungsten—Wolfram Company's plant in Unecha, Bryansk Oblast, and OOO Moliren's plant, in Roshal, Moscow region (Ministry of Natural Resources and Ecology of the Russian Federation, 2020, p. 244, 247–248).

OOO Malinovsky GOK (established by Primorsky GOK and subsidiary JSC A&IR Mining) was preparing to construct an open pit mine and beneficiation plant at the Skrytoye tungsten deposit in Primorskiy Kray. The mine and beneficiation plant were scheduled to be commissioned in 2024. Concentrates produced from the new operation would replace those from Primorsky GOK's Vostok-2 mine, which was running out of reserves (Ministry of Natural Resources and Ecology of the Russian Federation, 2020, p. 248–249).

Elbrus Mining Company LLC [a subsidiary of the State Corporation for the Promotion of the Development, Manufacture, and Export of High Tech Products (Rostec)] completed the first stage of a project to restart production from the former Tyrnauz tungsten-molybdenum mine in Kabardino-Balkariya Republic. After being granted the license to develop the deposit in 2018, Elbrus worked to ensure the safety of the former mine workings, collected ore samples for metallurgical testing, and completed a feasibility study, which was approved by yearend 2019. The complex was to include an underground mine, a beneficiation plant, and a hydrometallurgical plant with planned output of 4,500 t/yr of WO_3 (approximately 3,600 t/yr of tungsten) and 1,000 t/yr of molybdenum oxide. Rostec decided to proceed to the second stage of the project, which included the design, construction, and launch of the mining and processing operation. Wolfram Company reportedly had an offtake agreement for the tungsten and molybdenum from Tyrnauz, which Rostec reportedly hoped to have in production in 2023 (RBC Group, 2019; Sparks, 2020; Elbrusmetall JSC, undated a, b).

Rwanda.—Rwanda had numerous tungsten mining operations; most were artisanal and some were small-scale semi-industrial operations. In many of the operations, tungsten (as wolframite) was the principal commodity being mined; in some, wolframite was mined as a byproduct of tin (as cassiterite) and (or) niobium and tantalum (as coltan). Rwanda was included in the Dodd-Frank legislation discussed in the “Legislation and Government Programs” section and participated in the iTSCi program described in the “Congo (Kinshasa)” section.

Spain.—Daytal Resources Spain, S.L. (a subsidiary of Almonty) produced scheelite concentrate from its Los Santos Mine and beneficiation plant in Salamanca Province. During the year, Almonty decided that the operation would cease mining ore and began processing tailings to produce concentrate. As a result, production decreased, owing to lower-than-expected recovery rates (Almonty Industries Inc., 2020b, p. 7–8, 12).

In September, W Resources completed construction of the large-scale beneficiation plant at its La Parrilla tungsten and tin open pit mine in the Extremadura region in the Provinces of Badajoz and Caceres. The company began production of tungsten and tin concentrates from run-of-mine ore in late November. W Resources produced about 8 t of tungsten in concentrate by yearend and planned to ramp up production to reach design capacity of the “T2” phase of the project—2 million metric tons per year of ore mined, 2,700 t/yr of tungsten concentrate containing approximately 1,450 t/yr of tungsten, and 400 t/yr of tin concentrate (W Resources PLC, 2017, p. 2, 6–7, 10; 2020a, p. 2; 2020b).

Saloro SLU, the operator of the Barruecopardo joint venture [Oaktree Capital Management, L.P. and Ormonde Mining PLC (Ireland)], completed commissioning of the tungsten mine and beneficiation plant and began producing tungsten concentrate. Barruecopardo, in Salamanca Province, would be a 9-year open pit operation, with a potential for expansion underground. Ore would be beneficiated using gravity methods to produce approximately 2,060 t/yr of tungsten in scheelite concentrate at full production. During rampup, overall mine production and revenues were much lower than those forecast in the feasibility study, owing to low ore grades in the initial peripheral ore zones being mined and delays in accessing the main ore body. These issues resulted in the need for additional funding and the decision by minority partner Ormonde Mining to sell its interest in the project to the majority partner (Saloro SLU, 2019, p. 3, 7–8; Ormonde Mining PLC, 2020).

Rafaella Resources Ltd. acquired Galicia Tin and Tungsten, S.L., owner of the Santa Comba tungsten and tin mine in Galicia, northwest Spain. The underground mine at Santa Comba was previously mined from 1980 to 1985, and the project was permitted for underground mining and partially permitted for open pit mining. By yearend, Rafaella had started a drilling campaign to update the existing resource for mine planning and began ore-sorting and metallurgical test work. Commodities trading company Transamine Trading S.A. (Switzerland) agreed to provide financial and operational support for the project, including the purchase of 100% of the mine's production of tungsten and tin concentrates over a 3-year period. The company planned to complete a feasibility study, raise development capital, and fast track construction and commissioning to achieve production in 2021 (Rafaella Resources Ltd., 2020, p. 3–4).

United Kingdom.—Tungsten West Ltd. acquired the Hemerdon tungsten and tin project in Devon, northeast of Plymouth. The project consisted of the Drakelands open pit mine and beneficiation plant, which restarted production in 2015, but then closed in October 2018 when former owner Wolf Minerals Ltd. (Australia) went into voluntary administration. Tungsten West planned to complete a definitive feasibility study on the operation in time to restart production in late 2021 (Hotter, 2019).

Vietnam.—Nui Phao Mining Co. Ltd. (Masan Resources Corp.) sold tungsten concentrate from its Nui Phao open pit polymetallic mine in Thai Nguyen Province to the nearby Masan Tungsten LLC tungsten chemicals manufacturing plant. Masan Tungsten processed Nui Phao's tungsten concentrate and

tungsten raw materials from other sources—including tungsten concentrates and chemical intermediates such as calcium and sodium tungstate—to produce APT, blue and yellow tungsten oxides, and sodium tungstate powder. In 2019, the plant consumed 4,510 t of tungsten in concentrate from Nui Phao and 829 t of tungsten in raw materials from other sources, compared with 4,440 t from Nui Phao and 743 t from other sources in 2018. Total APT production, on the basis of tungsten content, decreased slightly from 4,910 t in 2018 to 4,820 t in 2019. During the year, Masan Tungsten made investments to increase the plant's production capacity. By early 2020, the plant had the capacity to process 19,000 t/yr, gross weight, of tungsten concentrate containing a minimum of 7,500 t/yr of tungsten and had the following production capacities: approximately 5,800 t/yr of tungsten in APT, 2,800 t/yr of tungsten in blue tungsten oxide, 1,500 t/yr of tungsten in yellow tungsten oxide, and 600 t/yr of tungsten in sodium tungstate (Masan Tungsten LLC, 2019; Masan Resources Corp., 2020, p. 23, 60, 64).

In September, as part of Masan Resources' plans to develop tungsten recycling capabilities and to become a leading integrated high-tech industrial material company, Masan Tungsten entered into an agreement to purchase the global tungsten business of H.C. Starck Group GmbH (Germany). H.C. Starck Tungsten Powders is a global leader in the development, production, and sale of high-performance tungsten metal powder, tungsten carbide powder, and tungsten chemicals, with plants in Canada, China, and Germany. The acquisition would broaden Masan Resources' raw materials supply and processing capability to include hard and soft tungsten scrap. Masan Resources estimated that H.C. Starck treated approximately 3,800 t/yr of tungsten in scrap on an annual basis (Masan Resources Corp., 2019; 2020, p. 32, 64).

Two additional companies produced APT and downstream tungsten materials from concentrates and scrap in southern Vietnam—Sanher Tungsten Vietnam Co. Ltd. in Dong Nai Province and Tejing (Vietnam) Tungsten Co., Ltd. in Tay Ninh Province. Two companies had the capability to produce ferrotungsten—Vietnam Youngsun Tungsten Industry Co., Ltd., at its plant in Halong City, Quang Ninh Province, and Asia Tungsten Products Vietnam Ltd. [Asia Tungsten Products Co., Ltd. (Hong Kong), a joint venture between ATC Alloys Ltd. and a private businessman], at its plant in the Vinh Bao district near the Port of Haiphong. In 2019, the Asia Tungsten Products plant's only production was from a contract processing run to demonstrate the operating condition of the plant, which had been on care-and-maintenance status during calendar years 2017 and 2018. The plant was operated continuously for 17 days in mid-2019, during which it processed about 180 t of tungsten concentrate and produced 150 t of ferrotungsten with an average grade of 75.6% tungsten (ATC Alloys Ltd., 2019).

Zimbabwe.—RHA Tungsten Pvt. Ltd. [National Indigenisation and Economic Empowerment Fund (NIEEF) and Premier African Minerals Ltd.] maintained its tungsten operation in northwestern Zimbabwe on care-and-maintenance status. According to Premier, NIEEF failed to provide the full funding it had agreed to provide and would not give up its equity and allow another company to fund the operation so that it could restart production. Premier continued its discussions

with NIEEF through the end of the year (Premier African Minerals Ltd., 2020, p. 3, 44).

Outlook

World supply of tungsten materials likely will continue to be dominated by China's production and exports. China's Ministry of Natural Resources maintained the total tungsten production quota for 2020 at 105,000 t (65% WO₃), equivalent to approximately 54,100 t of tungsten content (China Mining Association, 2020). In addition to maintaining production quotas, China's Government is expected to continue to manage the production and export of tungsten through various regulations and guidelines.

Roskill Information Services Ltd. (2020, p. 12–13) forecast that an increasing amount of global tungsten supply will need to come from new mine production to meet demand in the next decade. As discussed in the "World Review" section, in the next few years, tungsten concentrate production from Australia, Brazil, Kazakhstan, the Republic of Korea, Portugal, Russia, Spain, and the United Kingdom is expected to begin or increase as producers start or ramp up production from new or newly reopened mines or improve output from established mines. In addition, numerous companies worked to develop new mines or restart production from inactive mines in Africa, Australia, Eurasia, and North America, which could contribute to future supply. The amount, location, and timing of new production will depend, in part, on tungsten prices and (or) the companies' ability to acquire funding. Scrap will continue to be an increasingly important source of raw material for the tungsten industry worldwide.

Tungsten consumption is strongly influenced by general economic conditions. Future consumption of tungsten in cemented carbides, which is the leading end-use material, will depend on the performance of the following industry sectors: automotive and aircraft production; construction; electronics manufacturing, where cemented carbide microdrills are used on circuit boards; general manufacturing; large equipment manufacturing; mining; and petroleum and natural gas drilling.

The automotive sector is estimated to represent about 30% of global tungsten consumption, mainly as cemented carbide tools used for machining vehicle components. As a result, future growth in tungsten use is expected to be strongly influenced by trends in vehicle production. Because electric vehicles (EV) require less machining than vehicles with internal combustion engines, the projected transition from producing vehicles with internal combustion engines to producing EVs is expected to reduce the unit consumption of tungsten per vehicle produced and lessen the growth in consumption of tungsten in cemented carbides (Argus Media group, 2018a, p. 5; Roskill Information Services Ltd., 2020, p. 11, 57, 234–236).

The global shift towards using light-emitting diode lamps is expected to continue to reduce demand for tungsten mill products for incandescent and fluorescent lamps, but because lighting applications are estimated to represent less than 8% of overall tungsten use, this is not expected to have a large impact on overall tungsten demand. Increased use of additive manufacturing ("3D printing") could reduce the need for tungsten in cemented carbides and tool steels, although the fundamental need for tungsten as a tool material is expected

to remain into the foreseeable future. In contrast, trends that could result in increased tungsten consumption include growth in civilian aircraft production; increased military spending; more stringent clean air requirements, which could generate demand for tungsten chemicals in catalysts that remove nitrogen oxides from gaseous effluents; and the growing use of tungsten hexafluoride in semiconductor manufacturing (Argus Media group, 2018b, p. 5–6; Roberts, 2018, p. 22–23; Roskill Information Services Ltd., 2020, p. 11, 57, 267–268, 280).

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TABLE 1
SALIENT TUNGSTEN STATISTICS¹

(Metric tons, tungsten content, and dollars per metric ton unit, unless otherwise specified)

	2015	2016	2017	2018	2019
United States:					
Concentrates:					
Production	NA	--	--	--	--
Consumption	W	W	W	W	W
Exports	398	183	532	284	584
Imports for consumption	3,970	3,580	3,920	4,050	2,760
Stocks, December 31:					
Consumer	W	W	W	W	W
U.S. Government ²	11,600	11,600	10,200	8,990	8,330
Price, U.S. spot quotation ³	302	148	245	326	270
Ammonium paratungstate:					
Production	W	W	W	W	W
Consumption ⁴	W	W	W	W	W
Exports	310	108	97	106	34
Imports for consumption	1,270	1,020	2,230	2,200	1,430
Stocks, December 31, producer and consumer	W	W	W	W	W
Price:					
U.S. market ³	299	198	278	364	308
European free market ⁵	227	191	242	313	246
Ferrotungsten:					
Production	--	--	--	--	--
Consumption	224 ^r	97 ^r	94 ^r	126 ^r	111
Exports	29	23	45	104	43
Imports for consumption	269	236	209	143	96
Stocks, December 31, consumer	35	36	36	35	20
Price, U.S. free market ^{3,6}	30.21	29.88	37.28	45.91	32.27
Primary products:					
Net production ⁷	6,080	7,500	7,760	7,330	7,230
Consumption ⁸	11,100	10,400	11,300	11,800	11,800
Stocks, December 31:					
Producer ⁷	493	544	621	559	554
Consumer ⁸	541	531	551	519 ^r	496
U.S. Government ²	125	125	125	125	126
World, production of concentrate	83,700 ^r	78,400 ^r	81,400 ^r	82,200 ^r	83,800

¹Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

¹Table includes data available through October 8, 2020. Data are rounded to no more than three significant digits, except prices.

²Source: Defense Logistics Agency Strategic Materials.

³Annual averages calculated from weekly prices reported by Platts Metals Week.

⁴Reported by tungsten processors.

⁵Annual averages calculated from monthly prices reported by Metal Bulletin.

⁶Dollars per kilogram of contained tungsten.

⁷Includes tungsten metal powder and tungsten carbide powder produced from metal powder; excludes cast and crystalline tungsten carbide powder and chemicals.

⁸Includes ammonium paratungstate and other tungsten chemicals, ferrotungsten, tungsten metal powder, tungsten carbide powder, and tungsten scrap.

TABLE 2
U.S. GOVERNMENT NATIONAL DEFENSE STOCKPILE TUNGSTEN STATISTICS IN 2019¹

(Metric tons, tungsten content)

Material	Inventory, yearend ²		Annual Materials Plan ^{3,4}	Sales		Inventory decrease ⁵	
	Fiscal year ³	Calendar year		Fiscal year ³	Calendar year	Fiscal year ³	Calendar year
Ores and concentrates	8,370	8,330	1,360	805	798	805	663
Tungsten metal powder	125	126	125	--	--	--	-1
Total	8,490	8,460	1,490	805	798	805	661

-- Zero.

¹Table includes data available through August 21, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²The yearend inventories included 1 metric ton, gross weight, of tungsten alloy and 5 metric tons, gross weight, of tungsten-rhenium metal.

³Twelve-month period ending September 30, 2019.

⁴Potential disposal or sale. The Annual Materials Plan also included the possible acquisition of 5 metric tons, gross weight, of tungsten-rhenium metal.

⁵From previous year. Negative numbers represent an increase in inventory level.

Source: Defense Logistics Agency Strategic Materials.

TABLE 3
U.S. NET PRODUCTION AND STOCKS OF TUNGSTEN PRODUCTS^{1,2}

(Metric tons, tungsten content)

	Tungsten metal powder	Tungsten carbide powder	Total
<u>Net production:³</u>			
2018	W	W	7,330
2019	W	W	7,230
<u>Stocks, December 31, producer:</u>			
2018	W	W	559
2019	W	W	554

W Withheld to avoid disclosing company proprietary data.

¹Table includes data available through August 21, 2020. Data are rounded to no more than three significant digits.

²Data for cast and crystalline tungsten carbide powder and tungsten chemicals are withheld to avoid disclosing company proprietary data; not included in "Total."

³Net production equals receipts plus gross production minus quantity used to make other products listed.

TABLE 4
U.S. PROCESSORS OF TUNGSTEN IN 2019^{1,2}

Company	Plant location
Buffalo Tungsten Inc.	Depew, NY.
Chem-Met Co., The	Clinton, MD.
Elmet Technologies, Inc.	Lewiston, ME.
Global Tungsten & Powders Corp. ³	Towanda, PA.
Kennametal Inc.	Fallon, NV.
Do.	Huntsville, AL.
Niagara Refining LLC ⁴	Depew, NY.
Tundra Companies	White Bear Lake, MN.
Do. Ditto.	

¹Table includes data through August 21, 2020.

²Consumers of ammonium paratungstate, tungsten-bearing scrap, tungsten concentrates, and (or) tungsten oxides.

³A division of Plansee Group.

⁴A joint venture of Sumitomo Electric Carbide Inc. and New York Tungsten LLC (a subsidiary of Buffalo Tungsten Inc.).

TABLE 5
U.S. REPORTED CONSUMPTION AND STOCKS OF TUNGSTEN PRODUCTS^{1,2,3}

(Metric tons, tungsten content)

	2018	2019
Consumption by end use:		
Steels	84 ^r	82
Superalloys	572	562
Other alloys ⁴	W	W
Cemented carbides ⁵	6,950 ^r	6,940
Mill products made from metal powder	W	W
Chemical	88	88
Total	11,800	11,800
Consumption by form:		
Ferrotungsten	126 ^r	111
Tungsten metal powder	W	W
Tungsten carbide powder	7,210	7,200
Tungsten scrap ⁶	W	W
Other tungsten materials ⁷	88	88
Total	11,800	11,800
Stocks, December 31, consumer:		
Ferrotungsten	35	20
Tungsten metal powder	29	31
Tungsten carbide powder	404 ^r	392
Tungsten scrap ⁶	38	41
Other tungsten materials ⁷	13	13
Total	519 ^r	496

^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Total."

¹Table includes data available through August 21, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Does not include materials used in making primary tungsten products.

³Includes estimates.

⁴Includes welding and hard-facing rods and materials, wear- and corrosion-resistant alloys, and nonferrous alloys.

⁵Includes diamond tool matrices, cemented and sintered carbides, and cast carbide dies or parts.

⁶Includes tungsten bars.

⁷Includes tungsten chemicals.

TABLE 6
U.S. EXPORTS OF TUNGSTEN ORES AND CONCENTRATES, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2018			2019		
	Quantity		Value (thousands)	Quantity		Value (thousands)
	Gross weight (metric tons)	Tungsten content ³ (metric tons)		Gross weight (metric tons)	Tungsten content ³ (metric tons)	
Canada	9	5	\$100	5	3	\$61
France	(4)	(4)	29	33	17	265
India	(4)	(4)	4	19	10	30
Ireland	3	2	34	--	--	--
Netherlands	29	15	497	347	179	5,300
Philippines	--	--	--	26	13	55
Russia	--	--	--	19	10	108
Switzerland	58	30	1,040	39	20	407
Thailand	--	--	--	202	104	400
Turkey	7	3	15	--	--	--
United Kingdom	245	126	4,130	4	2	40
Vietnam	194	100	1,580	436	225	1,400
Other	5 ^r	3 ^r	93 ^r	1	(4)	27
Total	551	284	7,520	1,130	584	8,090

^rRevised. -- Zero.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²U.S. Census Bureau Schedule B number 2611.00.0000.

³Estimated from reported gross weight using 51.6% tungsten.

⁴Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7
U.S. EXPORTS OF AMMONIUM PARATUNGSTATE, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2018		2019	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
	Brazil	--	--	2
Denmark	41	\$362	--	--
Dominican Republic	5	23	--	--
France	2	22	--	--
Germany	34	192	14	120
Hungary	15	130	1	6
Japan	2	16	2	22
Mexico	(3)	7	15	133
Peru	5	41	--	--
Other	3 ^r	26 ^r	2	18
Total	106	818	34	313

^rRevised. -- Zero.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes other ammonium tungstates, such as ammonium metatungstate. U.S. Census Bureau Schedule B number 2841.80.0010.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 8
U.S. EXPORTS OF TUNGSTEN METAL POWDERS, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2018			2019		
	Quantity		Value (thousands)	Quantity		Value (thousands)
	Gross weight (metric tons)	Tungsten content ³ (metric tons)		Gross weight (metric tons)	Tungsten content ³ (metric tons)	
Australia	(4)	(4)	\$18	2	2	\$46
Austria	(4)	(4)	8	5	4	276
Belgium	33	26	1,260	4	3	224
Brazil	6	5	323	11	9	474
Canada	79	63	4,610	86	69	4,740
Chile	6	5	353	(4)	(4)	26
China	5	4	384	2	1	113
Czechia	25	20	870	14	11	815
France	8	7	587	8	6	459
Germany	27	21	1,630	18	14	1,110
India	31	25	931	15	12	889
Indonesia	2	2	136	3	2	145
Japan	3	3	226	4	3	244
Korea, Republic of	9	7	994	5	4	524
Mexico	49	40	2,820	30	24	1,670
Peru	6	5	348	4	4	256
Russia	2	2	101	3	2	135
Saudi Arabia	11	9	486	20	16	1,200
South Africa	6	5	560	7	5	748
United Kingdom	3	3	245	8	7	717
Other	12 ^r	9 ^r	768 ^r	8	7	627
Total	325	260	17,700	257	206	15,400

^rRevised.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²May include tungsten alloy powders. U.S. Census Bureau Schedule B number 8101.10.0000.

³Estimated from reported gross weight using 80% tungsten.

⁴Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. EXPORTS OF TUNGSTEN CARBIDE POWDER, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2018		2019	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Argentina	2	\$131	4	\$135
Australia	44	1,510	28	1,010
Austria	310	7,350	59	859
Belgium	7	114	2	193
Brazil	12	643	5	392
Canada	240	14,600	187	10,200
China	46	2,590	60	2,180
Czechia	119	3,130	25	482
Denmark	3	114	1	47
France	4	188	3	95
Germany	194	12,200	92	6,320
Hong Kong	1	97	5	292
India	13	787	15	565
Indonesia	6	324	5	365
Ireland	7	116	13	336
Japan	45	2,500	55	3,540
Korea, Republic of	13	874	10	542
Luxembourg	6	58	1	188
Malaysia	2	138	3	161
Mexico	3	129	13	501
Netherlands	5	139	4	187
Peru	3	168	3	180
Philippines	5	557	4	411
Saudi Arabia	(3)	13	7	414
Singapore	19	1,500	3	343
Spain	3	122	(3)	18
Taiwan	40	2,940	14	916
United Kingdom	19	1,630	18	1,290
Other	15	961 ^r	12	966
Total	1,180	55,700	650	33,100

^rRevised.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²U.S. Census Bureau Schedule B number 2849.90.3000.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 10
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY¹

Product and country or locality	Schedule B ² number	2018		2019	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Ferrotungsten and ferrosilicon tungsten:	7202.80.0000				
Brazil		2	\$59	8	\$34
Canada		3	106	6	103
China		17	39	--	--
El Salvador		9	28	--	--
Hong Kong		28	73	--	--
Japan		9	77	--	--
Netherlands		(3)	3	20	657
Singapore		3	7	--	--
South Africa		27	69	6	14
United Kingdom		2	5	3	7
Other		5 ^r	286 ^r	1	44
Total		104	752	43	859
Unwrought tungsten: ^{4,5,6}	8101.94.0000				
Canada		32	2,370	21	1,520
Germany		5	355	6	335
Mexico		8	551	5	305
Philippines		65	570	--	--
Singapore		5	502	(3)	32
Taiwan		(3)	13	18	196
Vietnam		7	183	--	--
Other		13 ^r	1,090 ^r	7	637
Total		135	5,630	56	3,030
Waste and scrap: ⁷	8101.97.0000				
Belgium		--	--	4	34
Canada		113	1,180	125	1,780
Finland		92	3,090	112	2,070
Germany		149	2,030	107	2,260
Hong Kong		--	--	7	57
Japan		52	772	59	832
Korea, Republic of		6	76	3	39
Malaysia		--	--	129	1,090
Netherlands		6	226	22	240
Pakistan		--	--	131	1,140
Philippines		--	--	23	199
Taiwan		--	--	13	231
United Kingdom		104	2,100	92	1,540
Vietnam		121	976	--	--
Other		1	25	3	67
Total		645	10,500	832	11,600
Wrought tungsten: ^{4,8}	8101.96.0000, 8101.99.1000, 8101.99.8000				
Austria		26	1,870	60	3,520
Canada		18	2,500	11	1,890
China		24	3,210	13	2,420
Costa Rica		5	666	8	1,080
Denmark		2	168	(3)	17
France		1	198	2	355
Germany		51	4,290	12	1,650
India		2	245	3	319
Israel		4	468	1	198
Italy		4	428	2	236
Japan		434	36,300	604	47,500
Korea, Republic of		3	586	5	848
Mexico		162	19,300	203	22,400

See footnotes at end of table.

TABLE 10—Continued
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY OR LOCALITY¹

Product and country or locality	Schedule B ² number	2018		2019	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Wrought tungsten: ^{4, 8} —Continued	8101.96.0000, 8101.99.1000, 8101.99.8000				
Netherlands		2	\$311	1	\$105
Philippines		(3)	53	3	269
Singapore		1	347	2	560
Taiwan		2	257	1	186
Turkey		2	273	(3)	68
United Arab Emirates		7	792	1	100
United Kingdom		6	1,570	4	1,120
Other		12 ^r	2,040 ^r	11	2,040
Total		768	75,900	947	86,800
Tungsten compounds: ⁹	2841.80.0040				
Canada		4	12	12	35
China		1	99	1	66
Egypt		1	18	--	--
Malaysia		3	34	1	10
Mexico		(3)	3	1	100
Other		1	124 ^r	(3)	14
Total		10	291	15	224

^rRevised. -- Zero.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Schedule B is the U.S. Census Bureau classification for products being exported from the United States.

³Less than ½ unit.

⁴May include alloys.

⁵Content estimated from reported gross weight using 95% tungsten.

⁶Includes bars and rods produced simply by sintering; excludes powders and waste and scrap.

⁷Content estimated from reported gross weight using 70% tungsten.

⁸Includes bars and rods other than those produced simply by sintering; profiles, plates, sheets, strip, and foil; wire; and other wrought products. Contents estimated from reported gross weights using the following percentages: 95% tungsten for Schedule B numbers 8101.96.0000 and 8101.99.1000; 80% tungsten for Schedule B number 8101.99.8000.

⁹Includes only other tungstates.

Source: U.S. Census Bureau.

TABLE 11
U.S. IMPORTS FOR CONSUMPTION OF TUNGSTEN ORES AND CONCENTRATES,
BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2018		2019	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Argentina	35	\$1,170	--	--
Australia	28	698	--	--
Bolivia	1,270	37,600	1,210	\$30,900
Brazil	2	70	11	338
Burma	7	227	--	--
Burundi	76	1,900	54	1,390
Congo (Kinshasa)	--	--	9	229
India	7	243	--	--
Mongolia	152	4,370	152	3,480
Nigeria	--	--	181	4,700
Poland	15	364	31	680
Portugal	766	24,500	536	17,500
Russia	222	7,310	189	5,320
Rwanda	27	819	23	635
Spain	663	19,100	278	7,300
Thailand	79	1,540	21	633
Uganda	84	1,440	61	1,180
United Kingdom	610	16,300	--	--
Other	2	66	2	70
Total	4,050	118,000	2,760	74,400

-- Zero.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States codes 2611.00.3000 and 2611.00.6000.

Source: U.S. Census Bureau.

TABLE 12
U.S. IMPORTS FOR CONSUMPTION OF AMMONIUM PARATUNGSTATE, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2018		2019	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
China	1,450	\$47,000	824	\$24,900
Germany	632	16,000	600	16,700
Japan	--	--	4	124
Kuwait	50	824	--	--
Mexico	2	35	--	--
Vietnam	61	1,680	--	--
Total	2,200	65,500	1,430	41,700

-- Zero.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes other ammonium tungstates, such as ammonium metatungstate. Harmonized Tariff Schedule of the United States code 2841.80.0010.

Source: U.S. Census Bureau.

TABLE 13
U.S. IMPORTS FOR CONSUMPTION OF FERROTUNGSTEN AND FERROSILICON TUNGSTEN, BY COUNTRY OR LOCALITY^{1,2}

Country or locality	2018		2019	
	Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
China	92	\$3,100	15	\$478
Korea, Republic of	8	297	27	822
Netherlands	8	233	--	--
Russia	12	397	32	935
Switzerland	19	643	6	229
Ukraine	--	--	5	147
Vietnam	4	127	11	325
Total	143	4,800	96	2,930

-- Zero.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States code 7202.80.0000.

Source: U.S. Census Bureau.

TABLE 14
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,
BY COUNTRY OR LOCALITY¹

Product and country or locality	HTS ² code	2018		2019	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Tungsten metal powders: ³	8101.10.0000				
Austria		29	\$1,330	132	\$5,490
Canada		230	12,300	279	11,700
China		838	37,700	1,100	41,000
France		8	570	1	49
Germany		13	990	24	1,530
Hong Kong		5	199	21	557
India		5	177	13	425
Israel		33	1,410	70	2,670
Japan		49	5,460	63	3,200
Korea, Republic of		203	9,990	131	5,560
Spain		1	151	3	119
United Kingdom		5	268	2	198
Vietnam		14	514	73	1,890
Other		4 ^r	168 ^r	2	145
Total		1,440	71,200	1,910	74,500
Tungsten carbide powder:	2849.90.3000				
Austria		321	14,600	347	14,400
Belgium		6	326	1	39
Canada		410	20,500	366	16,800
China		631 ^r	31,000 ^r	1,050	45,000
Finland		7	319	--	--
France		20	2,380	12	1,490
Germany		7	413	4	311
Hong Kong		13	711	5	203
India		--	--	10	156
Israel		105	5,400	134	5,120
Korea, Republic of		4	243	(4)	14
Mexico		1	31	3	76
United Kingdom		2	37	7	356
Vietnam		1	45	6	194
Other		3 ^r	191 ^r	2	90
Total		1,530	76,200 ^r	1,940	84,200
Unwrought tungsten: ^{3,5}	8101.94.0000				
China		182	7,290	214	8,510
Germany		1	87	5	462
United Kingdom		(4)	24	4	95
Other		1 ^r	89 ^r	2	138
Total		183	7,490	224	9,210
Waste and scrap: ⁶	2620.99.2000, 8101.97.0000				
Austria		302	3,510	154	2,630
Belgium		31	705	83	1,600
Brazil		7	192	42	706
Canada		70	1,160	260	4,870
Chile		12	209	21	424
China		424	14,900	389	11,900
Czechia		39	970	38	793
Estonia		--	--	19	361
France		--	--	105	1,810
Germany		450	11,600	640	12,700
Hong Kong		5	142	15	214
India		31	972	15	503
Ireland		24	378	16	308
Israel		9	256	14	364

See footnotes at end of table.

TABLE 14—Continued
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,
BY COUNTRY OR LOCALITY¹

Product and country or locality	HTS ² code	2018		2019	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Waste and scrap: ⁶ —Continued	2620.99.2000, 8101.97.0000				
Japan		110	\$1,070	60	\$840
Luxembourg		200	2,440	186	1,960
Mexico		442	9,120	403	7,820
Netherlands		33	958	--	--
Peru		3	58	11	320
Poland		387	10,300	369	8,250
Russia		38	1,090	5	166
Singapore		23	408	10	112
South Africa		16	367	--	--
Spain		14	235	10	182
Sweden		--	--	12	287
Taiwan		23	719	--	--
Thailand		--	--	16	413
United Kingdom		247 ^r	6,380 ^r	166	3,720
Vietnam		3	128	25	865
Other		14 ^r	463 ^r	3	97
Total		2,960	68,700 ^r	3,090	64,200
Wrought tungsten ^{3,7}	8101.96.0000, 8101.99.1000, 8101.99.8000				
Austria		53	7,250	33	5,430
Canada		6	914	22	1,400
China		372	31,500	419	33,100
Czechia		4	823	4	797
France		6	1,200	10	1,760
Germany		11	2,550 ^r	7	1,850
Hong Kong		3	237	1	69
Japan		12	6,540	26	7,580
Singapore		3	531	2	732
Spain		1	125	2	378
Sweden		3	772	2	838
Taiwan		3	478	4	475
Thailand		19	5,480	8	2,150
United Kingdom		3	864	2	602
Other		8 ^r	2,460 ^r	8	2,740
Total		507 ^r	61,700 ^r	551	59,900
Tungsten oxides:	2825.90.3000				
China		675	25,300	301	7,960
Germany		42	1,350	124	3,450
Netherlands		--	--	20	525
Vietnam		13	668	120	3,100
Other		(4)	3	(4)	4
Total		730	27,400	565	15,000
Other tungstates:	2841.80.0050				
Australia		(4)	59	(4)	80
China		3	111	13	249
Germany		6	477	6	450
Hong Kong		--	--	42	920
India		16	481	37	994
Philippines		--	--	131	2,860
Taiwan		--	--	421	6,050
Vietnam		559	12,800	548	10,200
Total		584	13,900	1,200	21,800

See footnotes at end of table.

TABLE 14—Continued
 U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS,
 BY COUNTRY OR LOCALITY¹

Product and country or locality	HTS ² code	2018		2019	
		Quantity, tungsten content (metric tons)	Value (thousands)	Quantity, tungsten content (metric tons)	Value (thousands)
Other tungsten compounds and chemical products: ⁸	2827.39.4000, 2850.00.1000				
Canada		--	--	3	\$63
Colombia		1	\$11	5	90
Germany		25	495	35	642
Japan		88	1,550	90	1,590
Other		1 ^r	46 ^r	1	65
Total		115	2,100	135	2,450

^rRevised. -- Zero.

¹Table includes data available through August 11, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States.

³May include alloys.

⁴Less than ½ unit.

⁵Includes bars and rods produced simply by sintering; excludes powders and waste and scrap. Content estimated from reported gross weight using 95% tungsten.

⁶Includes ash and residues, mainly tungsten.

⁷Includes bars and rods other than those produced simply by sintering; foil, plates, profiles, sheets, and strip; wire; and other wrought products. Contents estimated from reported gross weights using the following percentages: 95% tungsten for HTS codes 8101.96.0000 and 8101.99.1000, 80% tungsten for HTS code 8101.99.8000.

⁸Includes tungsten chlorides, hydrides, and nitrides.

Source: U.S. Census Bureau.

TABLE 15
TUNGSTEN: WORLD CONCENTRATE PRODUCTION, BY COUNTRY OR LOCALITY¹

(Metric tons, tungsten content)

Country or locality ²	2015	2016	2017	2018	2019
Australia	348	108	20 ^c	20 ^c	20 ^c
Austria	861	954	975	936	892
Bolivia ³	1,460	1,110	994	1,365	1,064
Brazil	432	323 ^r	411 ^r	400 ^{r,c}	400 ^e
Burma ^{e,4}	144	182 ^r	216 ^r	77 ^r	82
Burundi ^{e,5}	9	63	120	100	130
Canada ⁶	1,600 ^c	--	--	--	--
China	67,000	64,000	67,000	65,000	69,000
Congo (Kinshasa) ^c	51	73	120	180	190
Korea, North ^{e,7}	70	50	310	1,410	1,130
Mongolia	351	732	510	1,938	1,900 ^e
Nigeria ^{e,8}	25 ^r	7 ^r	2 ^r	24 ^r	25
Peru	110	--	--	--	--
Portugal	474	549	669	715	518
Russia	3,262	2,707 ^r	2,144 ^r	2,234 ^r	2,200 ^e
Rwanda ^{e,3}	850	820	720	920	900
Spain	835	699	564	856 ^r	603
Thailand ^{e,9}	35	33	65	69	40
Uganda	36	41	62	188 ^r	190 ^e
United Kingdom	155	736	1,086	1,000 ^{r,c}	--
United States	NA	--	--	--	--
Vietnam ¹⁰	5,600	5,200	5,400	4,800	4,500
Zimbabwe ¹¹	NA	NA	NA	NA	--
Total	83,700 ^r	78,400 ^r	81,400 ^r	82,200 ^r	83,800

^cEstimated. ^rRevised. NA Not available. -- Zero.

¹Table includes data available through October 8, 2020. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²In addition to the countries and (or) localities listed, Colombia, the Republic of Korea, Kyrgyzstan, and Uzbekistan may have produced tungsten concentrates, but available information was inadequate to make reliable estimates of output.

³Production based on reported exports.

⁴Based on 2015–19 calendar year production of tungsten concentrates and 2015–18 fiscal year production of tin-tungsten concentrates reported by the Central Statistical Organization.

⁵Based on gross weight reported by the Institut de Statistiques et d'Etudes Economiques du Burundi.

⁶Datum for 2015 based on half-year production from North American Tungsten Corp. and an estimate for production from July through October 2015.

⁷Production estimated based on imports reported by China.

⁸Production estimated based on reported imports from Nigeria.

⁹Based on data from the Department of Primary Industries and Mines.

¹⁰Mine production reported by the International Tungsten Industry Association.

¹¹Production began in 2015, but information was inadequate to make reliable estimates of output.